

## **Climate Change Commission: Adaptation Sub-Group**

### **Adaptation of the Built Environment**

#### **Introduction**

It is accepted that climate change will happen and that policies are needed to support the implementation of spatial and physical adaptation to enable communities to respond to either predicted climate change effects or, more critically, to improve our capacity to respond to the uncertainties posed.

Whilst there are uncertainties in the actual effects of climate change, evidence suggests that weather conditions are likely to become more severe and there is the potential for increased flooding, hotter summers, heat islands, increased coastal erosion, higher sea levels, wetter winters and increased dry periods.

This all indicates the need for the built environment to be resilient to extremes in the climate.

This paper focuses on adaptation of the built environment to climate change, although in some situations action to adapt to climate change will also achieve reductions in emissions. The paper discusses adaptation to the built environment; other work is ongoing to consider related developments such as infrastructure and energy supply.

#### **Background**

The Welsh Assembly Government has, over the past two years taken forward the quality design and planning for climate change agenda, which has particular relevance to the built environment. This has included emerging and final policy and the drafting and amendments of technical guidance. In summary these are:

- Ministerial Interim Planning Policy Statement (MIPPS) (01/2008) Planning for Good Design;
- Planning for climate change package including a draft climate change Ministerial Interim Planning Policy Statement (12/2006);
- Update to Technical Advice Note (TAN) 12: Design to reflect climate change amendments;
- Further consultation on planning for climate change MIPPS (07/2008);
- A new TAN 22 on Sustainable Buildings (in preparation); and
- A commitment to bring together previous MIPPS into consolidated version of Planning Policy Wales.

#### **Location of Development**

The location and position of new development is a crucial consideration in adapting to climate change. The restriction of developments on sites vulnerable to flooding is a clear need. There need to be clear robust local planning policies to emphasise this, and also the flood risk maps contained in national planning guidance, through TAN 15 must be enhanced to be useful and relevant at the local level.

Furthermore, TAN15 needs to be applied rigorously at the Local Development Plan (LDP) stage. There is a need to:

- Demonstrate that all sites outside the flood risk area have been considered and shown that none are suitable before sites in flood risk areas are included;
- If sites have to be located in the flood risk zone, it needs to be demonstrated that sites at least risk have been included - this may need a strategic flood consequence assessment (not all sites in a flood risk area carry the same risk);
- Prove that the sites chosen are capable of meeting the standards set out in TAN15

Strategic Flood Consequence Assessments (SFCA) are a useful tool that can be used for forward planning, development control and emergency planning purposes. Sufficient resources should be provided to encourage their use.

The increase in coastal erosion also means that developments along the coast need to consider this threat. New development should be discouraged in these locations and subject to tight limitations (similar to TAN15's restrictions for areas of flood risk). Measures need to be taken to either protect or introduce managed retreat from existing developments in coastal locations; Management Plans are up for review, LDPs need to take them on board together with the new sea / storm predictions and review decisions on coastal realignment. It is anticipated that emerging national planning policy will support this.

Location also needs to plan in efficient movements of people, water, food production and energy to reduce wastage in preparation to the scarcities of resources likely to be experienced in the future. Masterplanning is an important way of planning future developments in a holistic manner and in relation to existing developments and resources. Water Cycle Plans, prepared as part of the evidence base for LDPs, would allow climate change policy to be incorporated into an assessment of the infrastructure capacity for water supply, sewerage disposal, flood risk management and surface water drainage.

While waste reduction is clearly a priority, climate-related problems are predicted for waste management sites. These include:

- Increased problems with odour and vermin, and accelerated decomposition associated with increased summer temperatures.
- Dust problems with drier summers.
- Disruption of maintenance and construction associated with more frequent extreme events.

These potential threats require waste operators to improve their site management and long-term planning and to develop contingency plans with local authorities. The Environment Agency will consider such climate change adaptation requirements when revising its regulatory guidance.

### **Existing Building Stock**

At the current time the existing housing (i.e. not newly constructed) is by far the largest share of the housing stock. Adapting housing to climate change effects is therefore essential. Many of the ways of adapting the existing stock also achieve emission reduction.

The existing building stock, whatever its use, i.e. housing, commercial, industrial, public use etc. all need to be adapted to be resilient to extreme weather conditions, including

heavy rain penetration, high winds, and extreme heat. This will involve a combination of increasing the performance of the external fabric of the buildings i.e. roofs, walls and windows, using cladding or building skins impervious to rain, developing drainage to cope with higher rainfall and increasing insulation to deal with higher, as well as low temperatures. For those buildings already in areas of risk of flooding it will be important to adapt the building to cope with water ingress or seek opportunities, through regeneration, for their removal.

Whilst the focus of this paper is on adaptation to climate change, any changes made to adapt must not increase emissions e.g. installing air conditioning to combat an increase in temperatures.

In July 2008, the Welsh Assembly Government published a guide - Improving your home: A Climate Change Guide. The guide is practical and includes various projects from simple to more complex schemes that householders can implement. Whilst much of the focus is on emission reduction, it also includes action to support adaptation. Suggestions include various methods of insulation, proposals for reducing the impact of flooding on homes, re-roofing and rendering of walls, cooling and adaptation, drainage and water saving. It will be essential for this guide to be circulated widely and to raise awareness with householders, builders and trades, and DIY sales outlets.

The messages from the Guide and other reports, need to be taken up in training and re-skilling courses, and reinforced with further awareness raising and incentives to promote a more thorough understanding and uptake of climate proofing / resilience measures by householders and builders and trades. The Federation of Master Builders is a particularly useful conduit to the many small businesses operating in this sector.

Motivating people to include climate proofing in home improvements needs a strong lead and promotional programme from the Assembly Government. More needs to be learned from the Energy Advice and Energy Efficiency programmes that much more vigorous promotion is needed with exhibitions, free courses and demonstration projects, on a community by community basis. The new Energy Performance Certificates (EPCs) could be extended to include Climate Proofing certificates.

### **Historic Buildings**

The impacts of climate change have the potential to irreparably damage historic buildings resulting in loss of the cultural, social and economic benefits they provide. Poorly designed adaptation measures can threaten the significance and integrity of important historic assets. Historic buildings constructed when the climate was significantly different may be particularly at risk, for example guttering and roofs not designed with capacity for intense periods of heavy rain increasingly experienced in Wales.

The principal impacts of concern for historic buildings are:

- storm rainwater incursion through roofs/flashings/gutters;
- gales causing structural damage (including through tree damage);
- changes in the distribution of pests that threaten the integrity of historic buildings;
- subsidence and cracking after periods of drought; and
- flood damage to the foundations and structure itself.

Although these to a large extent threaten all building types, the nature of some historic buildings increases their vulnerability, or makes it more challenging to improve their

resilience. Whilst some impacts can be accommodated by means of increased frequency of regular maintenance and repair, others will require positive prevention or reactive work. In some cases it will be possible to do so without compromising their character or historic importance. Listed buildings will require a particularly sensitive approach. However more flexibility will be required in cases where climate change is likely to jeopardise the structural integrity or conservation interest of the building / structure (e.g. through coastal erosion and flooding, heavy storms / rainfall events, humidity, subsidence or cracking). In such cases a range of options will need to be considered, with possible responses including defending or adapting the buildings / structures or their immediate environment, or - conceivably - abandonment. In very rare cases reconstruction in an alternative location, or in an alternative 'climate resilient' way, may be justifiable. In all cases a holistic and sustainable approach will be required, involving consultation with a range of stakeholders.

Continued use of old buildings require traditional and locally sourced materials for their upkeep and repair, thereby creating a market demand for certain materials. There are potential economic and social benefits of 'upskilling' local labour forces in order to meet demand for traditional skills required for maintaining historic buildings.

At present the requirement to pay 17.5% VAT for all maintenance and improvement work on historic buildings is currently a significant burden. This may also act as a deterrent to adapting buildings to climate change. A number of organisations are suggesting that reducing the rate to 5% could benefit the management of the historic environment.

The Historic Environment Advisory Group (HEG) is coordinating activity around the impacts of climate change on the Welsh historic environment. It will be essential to understand the most significant impacts and identify the types of buildings or sites most at risk; the risk assessment being led by HEG will be useful in identifying vulnerable sites. There is a need for guidance for practitioners, such as Conservation Officers and architects, to support them in working on issues of climate change adaptation. Sharing good practice with the public and professionals will also encourage appropriate adaptation and guide the owners of historic buildings. It will be necessary to periodically revisit planning policy and guidance to ensure it appropriately takes account of appropriate and sensitive adaptation measures.

### **New Buildings**

Whilst new housing stock currently only accounts for about 1% of the total, by 2050 it is estimated that houses being built from now on will account for a third of the total housing stock. New private housing stock currently being constructed or planned is therefore an essential element for the future, which needs to be addressed urgently.

As with the adaptation of the existing stock, new buildings need to take account of climate change effects at the start of their design. New buildings have the advantage of being able to introduce measures that are not possible for existing buildings. These particularly relate to the location of the building, more extensive sustainable drainage systems, changes for lower floors to either be raised at higher levels or designed to accommodate flooding and the aspect of buildings to assist with temperature control etc.

The biggest challenge to overcome here is the need to develop understanding and awareness amongst professions and skilled trades in adaptation measures and also for consumers to demand such measures. The message that buildings may lose their value,

or become too expensive to maintain because of climate change effects, due to their location or construction, must be understood.

Adaptation measures should be implemented as provided for in the Code for Sustainable Homes. This includes water efficiency, for which the need to develop understanding and awareness amongst skilled trades has been recognised by Dŵr Cymru Welsh Water with their 'green plumbers' programme. Such programmes are essential to deliver the outcomes from the Code for Sustainable Homes in helping adapt new buildings to climate change and could be expanded to other areas including, for example, gardens and electrical contactors in dealing with lower energy use appliances.

If the Welsh Assembly secures the powers, it should use tighter Building Regulations to drive climate-proofing, particularly in regard to the wetter winter climates predicted in Wales.

### **Water Resources**

Consideration of water resources is a vital component of adapting our built environment to climate change. Recent modelling by the Environment Agency has shown that there may be a 50-80% summer decrease in naturalised river flows by the 2050s in Wales. Adaptation to this reduction in water resources needs to consider both demand management as well as source substitution. The timing and intensity of adaptation measures needs to be assessed to ensure the most sustainable outcome.

Rainwater harvesting from buildings and other structures, grey water recycling and other water recycling technologies are becoming increasingly popular for generating non-drinking water for domestic, agricultural, industrial and commercial use.

Incorporating grey water (domestic waste water) recycling systems into the design process can assist in adapting to hotter drier summers when pressure on conventional supplies is likely to be greatest. Grey water can be used in place of these conventional supplies in, for example, irrigation and toilet systems.

While grey water systems save water, they also use energy. Retrofit of community or individual household rainwater harvesting and use systems has a high carbon cost and may be less dependable during drier summers. The evidence indicates that water efficiency should be considered before source substitution such as greywater re-use or rainwater harvesting based on payback periods and the carbon cost of these options.

A life-cycle-analysis to estimate the carbon costs of these options relative to the baseline has been undertaken, with water efficiency measures having a lower carbon cost compared to baseline and source substitution. Cheaper and less energy-intensive ways of saving water include low-flush toilets, low flow taps, low flow showers and waterless urinals. The evidence suggests that these options should be pursued before water recycling options. Additionally, behaviour change programmes have significant potential in helping us adapt to climate change and can be linked with saving energy, reducing waste and sustainable transport.

Further research is required to assess the benefits for Wales. However a sustained 10% reduction in water use has been observed with such methods applied in other countries.

## **Green Infrastructure**

Green infrastructure can be defined as the network of spaces and natural elements that are present in and interconnect areas. Below are examples:

At local/neighbourhood scale

- street trees and hedgerows
- pocket parks
- cemeteries
- small woodlands
- rivers and floodplains

At town/city scale

- city parks
- green networks
- forest parks
- lakes
- rights of way
- rivers and floodplains

At city-region/regional scale

- regional parks
- rivers and floodplains
- long distance trails
- reservoirs

Effective adaptation to climate change can be facilitated by green infrastructure approaches to planning and design. Green spaces and corridors help to cool our urban environments, improve air quality and ameliorate surface run-off. Research has shown that even individual trees, as long as they have the potential and space to achieve a reasonable size, can perform these functions. A green infrastructure planning approach will reduce flood risk, protect building integrity and improve human health and comfort in the face of more intense rainfall and higher temperatures. Well-connected green infrastructure also provides wildlife corridors for species migration in the face of climate change as well as wider benefits for recreation, community development, biodiversity, food provision and place shaping.

In addition, rivers and floodplains need to be restored if they are to serve their natural function.

Both the planning policy framework in Wales, as well as associated communication messages, need to be better aligned to promote the benefits of urban greenspace and especially the role of trees. Otherwise the perception that the costs and risks of managing urban and street trees outweigh their benefits, will continue to dictate local decision-making.

## **Green roofs**

Green roofs, roofs which are covered with vegetation and soil, can reduce run-off and subsequently relieve the pressure on drainage systems, particularly at times of high intensity rainfall. Additionally, the benefits afforded to biodiversity can be significant by providing wildlife habitats, particularly in urban areas. They also enhance the thermal performance of buildings and have an important role to play in reducing the urban heat

island effect. Green roofs also have the potential to contribute to wider landscape character in a particular location.

### **Plant species selection**

Understanding what species to plant, where to plant them and the conditions different species require in order to thrive is also important. This is invaluable in the face of changing climatic conditions, particularly arising from the impacts on the quality and availability of water and the potential increase in pests and disease.

### **Drainage**

Sustainable Drainage Systems (SuDS) reduce the negative impacts of development on surface water drainage. SuDS can minimise the risk of flooding and pollution via attenuation and storage with additional benefits including improvements to local environmental quality, the creation of habitats for biodiversity and general improvement to the quality of life for local communities.

Rainfall is being increasingly channelled into public sewers, sometimes overloading them and causing flooding and pollution. SuDS allow for rain water to be drained away through natural watercourses, as opposed to being directed into drains. SuDS that use trees as part of their implementation are particularly adept at achieving deeper percolation of storm water, as the tree roots penetrate more deeply into the ground and create natural drainage channels away from the surface. By reducing the pressure on the drainage system they would be able to cope better in periods of high rainfall and thereby reducing flooding. The vast majority of developments currently allow for water from roofs etc. to be channelled into the main drainage system.

It isn't just larger development sites which require consideration of drainage options. The increase in conservatories, and paving and decking in gardens exacerbates the problem. Whilst some developments such as this might not require planning permission, local planning authorities (LPAs) should sign post members of the public to SuDS options available to them.

SuDS mimic nature and aim to put water back into the environment. There is a wide range of drainage options including:

- Soak aways
- Retention ponds and Wetlands
- Swales
- Permeable surfaces
- Green roofs

A particular barrier for SuDS not to be taken forward is the unwillingness of authorities to formally adopt SuDS schemes generally and specifically on highways and take on their maintenance; instead it is common to opt for hard landscaping. There are currently pilot schemes underway to demonstrate in Coed Poeth, Pwllheli, Llynfi Valley and Llanelli. Through the pilot studies it is aimed to create a toolbox of solutions, focus on achieving an integrated approach and address adoption principles, alternative solutions, maintenance and legislative problems.

There needs to be an increase in the demand for SuDS schemes to accompany proposals for developments through planning conditions. There is currently a tool under development to assist planners to determine the most appropriate form of SuDS scheme for different developments. The widespread use of SuDS also needs to be adopted, for

example traffic calming measures can incorporate SuDS devices through the use of green kerbs - 80% of run off can be absorbed by grass kerbs which contain suitable planting.

## Responses

In addition to the responses contained with the paper, the following are overarching responses required to adapt the built environment to climate change.

There is a strong case for strengthening the requirement to ensure that decisions concerning the location, layout and design of developments fully take into account the need to consider all adaptation factors. This might best be achieved by new planning policy guidance on the one hand, for which there are proposals, and a strengthening of the appropriate areas of the building regulations on the other.

It will also be worthwhile to explore the possibility of developing a 'climate proof' rating along the lines of the current home energy rating reports, which are prepared when a home is surveyed and the results are fed back to the potential owners.

Resources needed for pre application discussion to ensure applications for developments and their location, build in adaptation issues from the start both for LPAs and statutory consultees such as the Environment Agency.

Local area adaptation strategies should be established. Each area will have different issues to face, and this will enable areas to focus on the issues which are pertinent to them.

Ensuring all built environment professionals, including planners, engineers, architects, landscape architects and surveyors are aware of the practical measures to adapt to climate change and the appropriate responses is essential. This can be done through specific training and also demonstration projects.

In addition providing briefings to those involved throughout the construction industry will be imperative. Working with organisations such as the Federation of Master Builders will provide direct access to the many small operators in this sector, who are a hard to reach group.

## Further Information

Landscape Architecture and the challenge of Climate Change - Landscape Institute Position Statement, October 2008

The Pitt Report – Learning Lessons from the 2007 Floods

RTPI response to the Defra Consultation Improving Surface Water Drainage

SuDS – Innovation or a tried and tested Practice

Dŵr Cymru Press Release: "Wales Needs More Natural Drainage to Reduce Sewer Flooding"

Dŵr Cymru: Our Sustainable Future

National Trust: From Source to Sea Working with Water

Cost-benefit of SUDS retrofit in urban areas:

<http://publications.environment-agency.gov.uk/pdf/SCHO0408BNXZ-e-e.pdf>

Green Paper on Adaptation to Climate Change, European Commission, June 2007

Environment Agency (2008) *Climate Change and River Flows in the 2050s*,  
<http://publications.environment-agency.gov.uk/pdf/SCHO1008BOSS-e-e.pdf>

Environment Agency (2008) *Greenhouse gas emissions of water supply and demand management options*, <http://publications.environment-agency.gov.uk/pdf/SCHO0708BOFV-e-e.pdf>

TCPA, *Climate change adaptation by design: a guide for sustainable communities*,  
Shaw, R., Colley, M., and Connell, R., London, 2007

Building Knowledge for a Changing Climate (BKCC - a partnership between EPSRC and UKCIP) <http://www.k4cc.org/bkcc>